

# **Sea ice changes affecting Alaska:**

**Offshore transportation, coastal communities, marine ecosystems**

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**University of Alaska, Fairbanks**

*Symposium: Impact of an Ice-Diminishing Arctic on Naval and Maritime Operations*

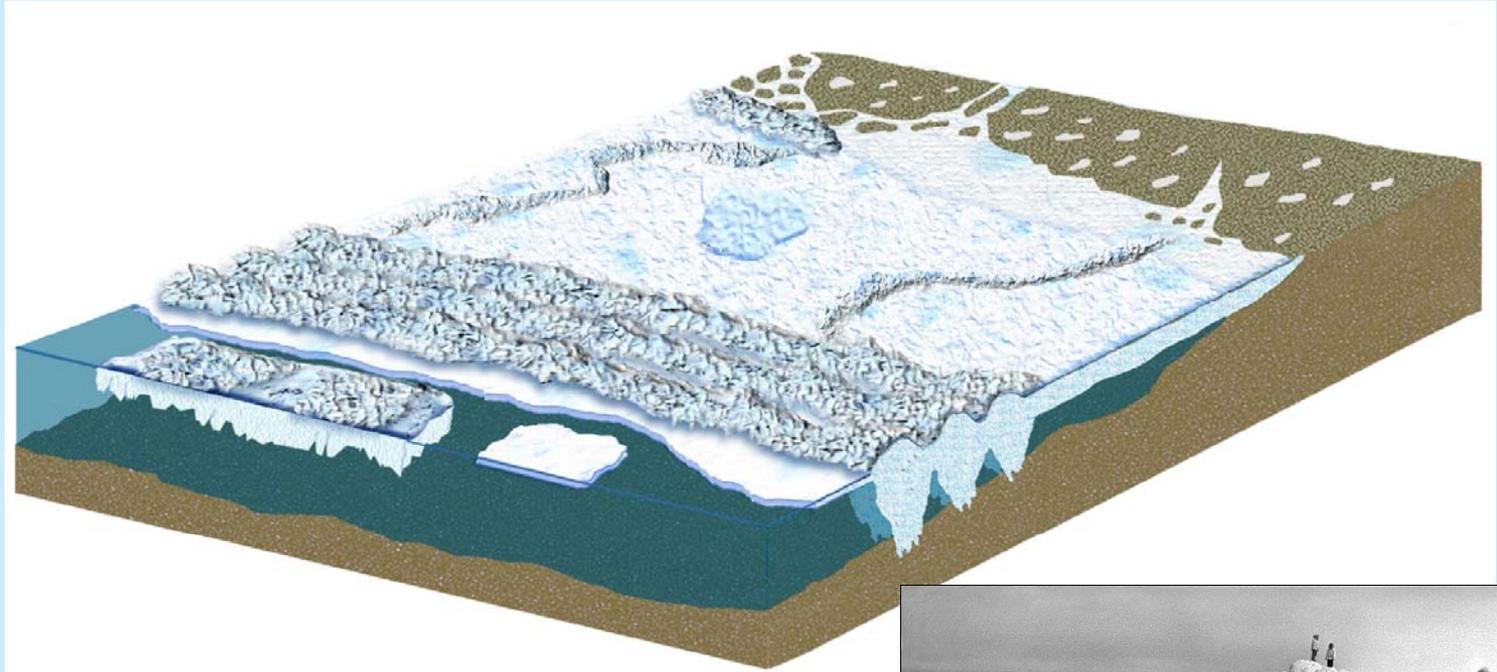
*July 12, 2007*

# Changes in coastal ice regime



- **Changes in lead distributions and landfast ice extent between 1993 and 2004**
- **AVHRR and Radarsat SAR imagery analysed**
- **Coastal ice observations at Barrow**

# Alaska coastal and landfast ice



Barrow Whaling camp  
(Photo: Bill Hess)

■ ■ ■  
Minimum Mean Maximum

October

November

December

January

February

March

April

May

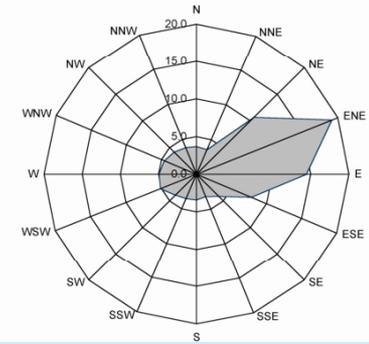
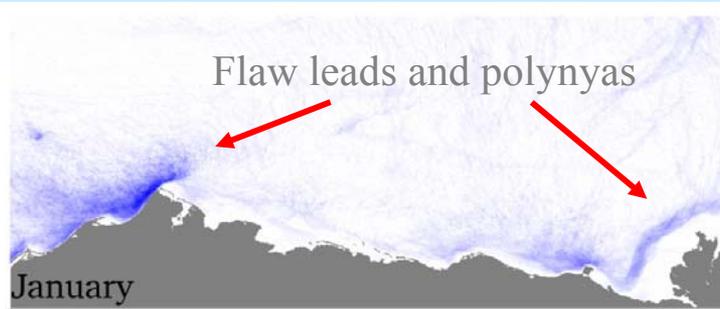
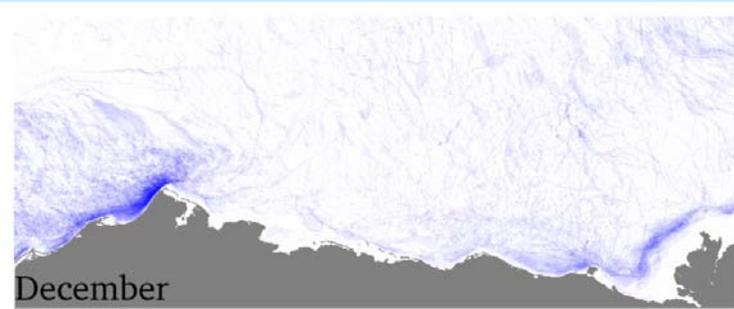
June

July

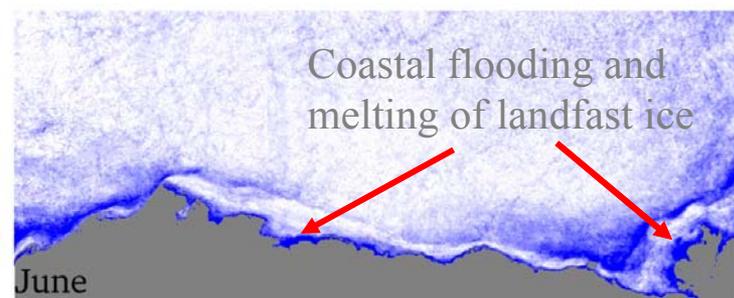
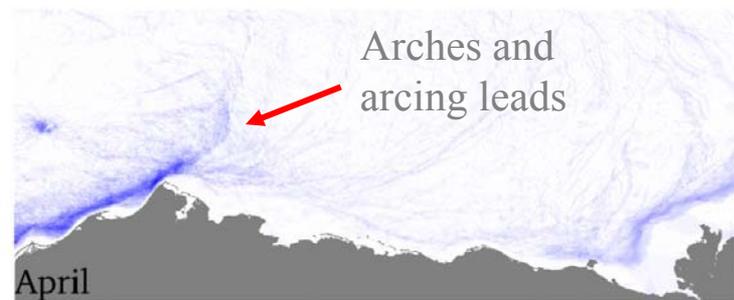
**Mean  
landfast ice  
edge  
locations and  
landfast ice  
extent have  
been fairly  
stable**

**Mahoney et al., 2007**

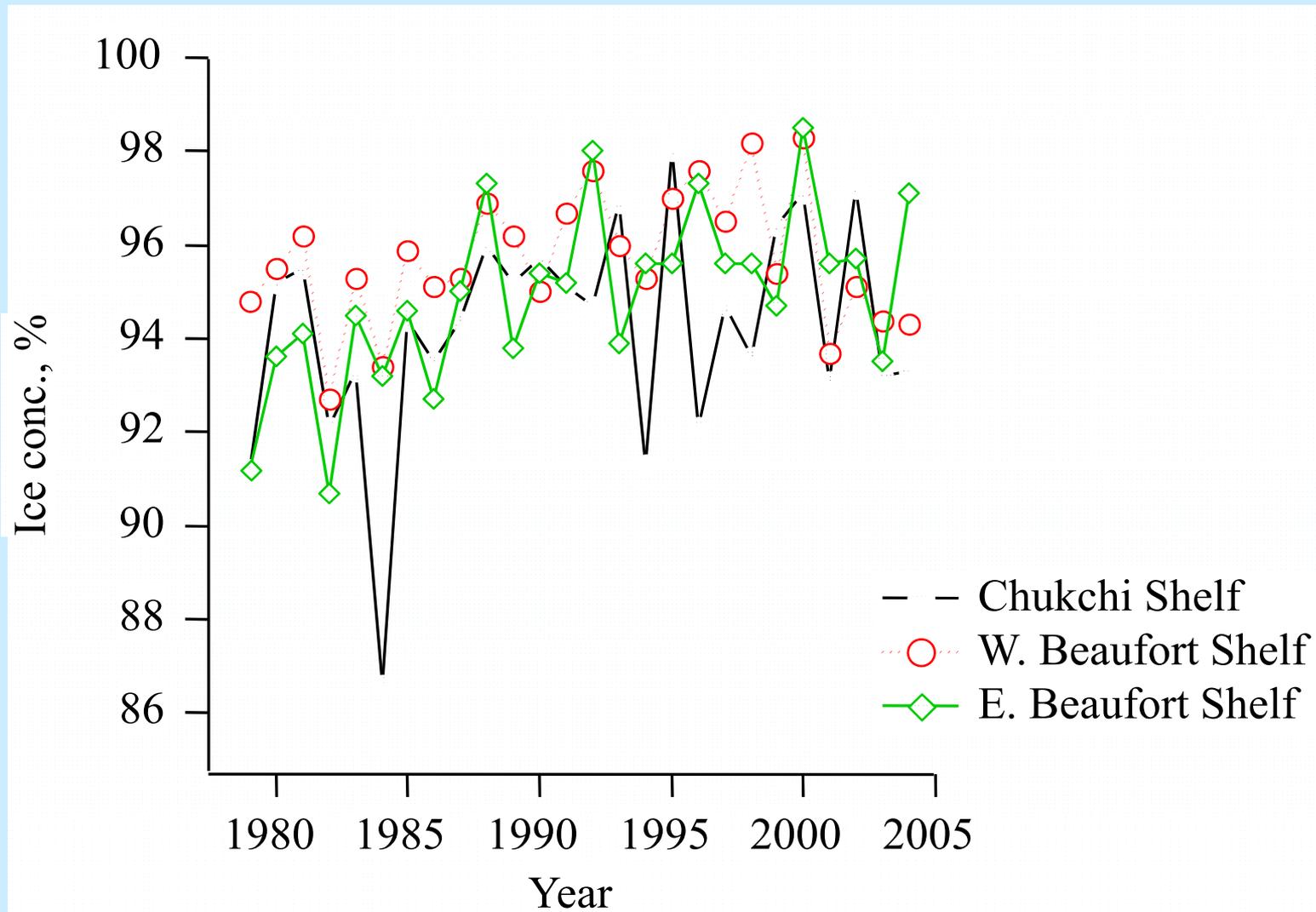
# Winter lead occurrence patterns (1993-2004)



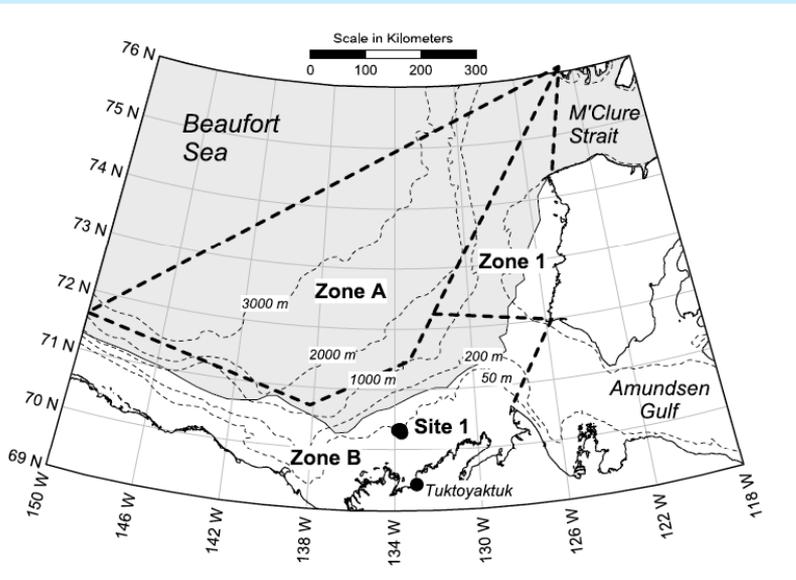
- **Winds mostly from ENE at Barrow, 1971-2000**



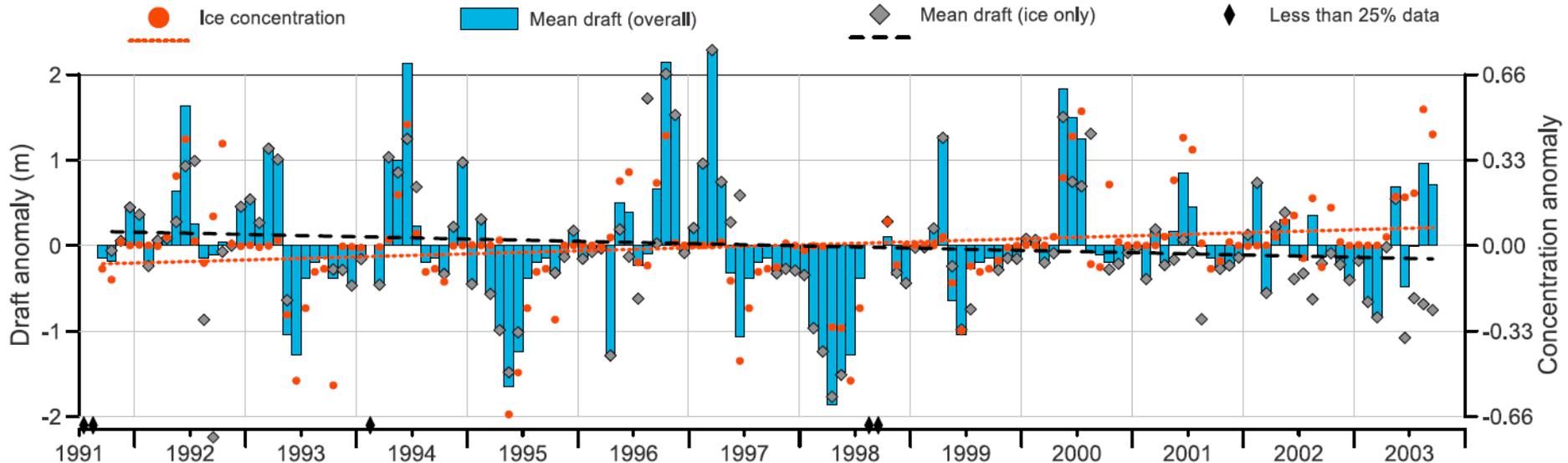
# Winter concentration of sea ice along N. Alaska coast (SMMR/SSMI)



# Beaufort Sea Ice thickness change



- Melling et al. (GRL, 2005): No significant thinning trend for pack ice over inner Beaufort Shelf 1991-2003
- Coastal air temperature increased by 1.6 K 1991-2003

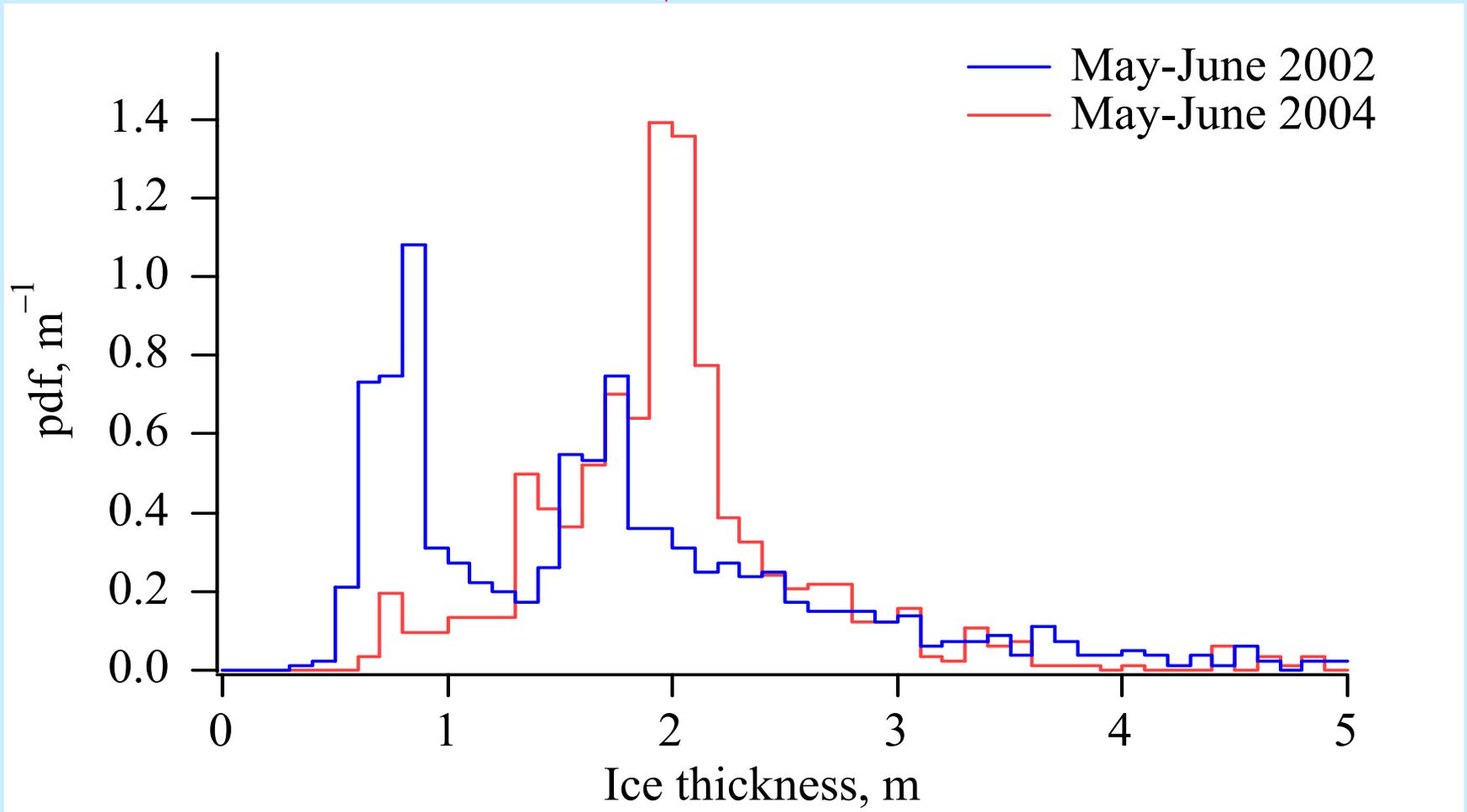


# Offshore ice thickness measurements: thinning or thickening? Lack of data

Undeformed  
ice



Level MY ice and  
rafted FY ice

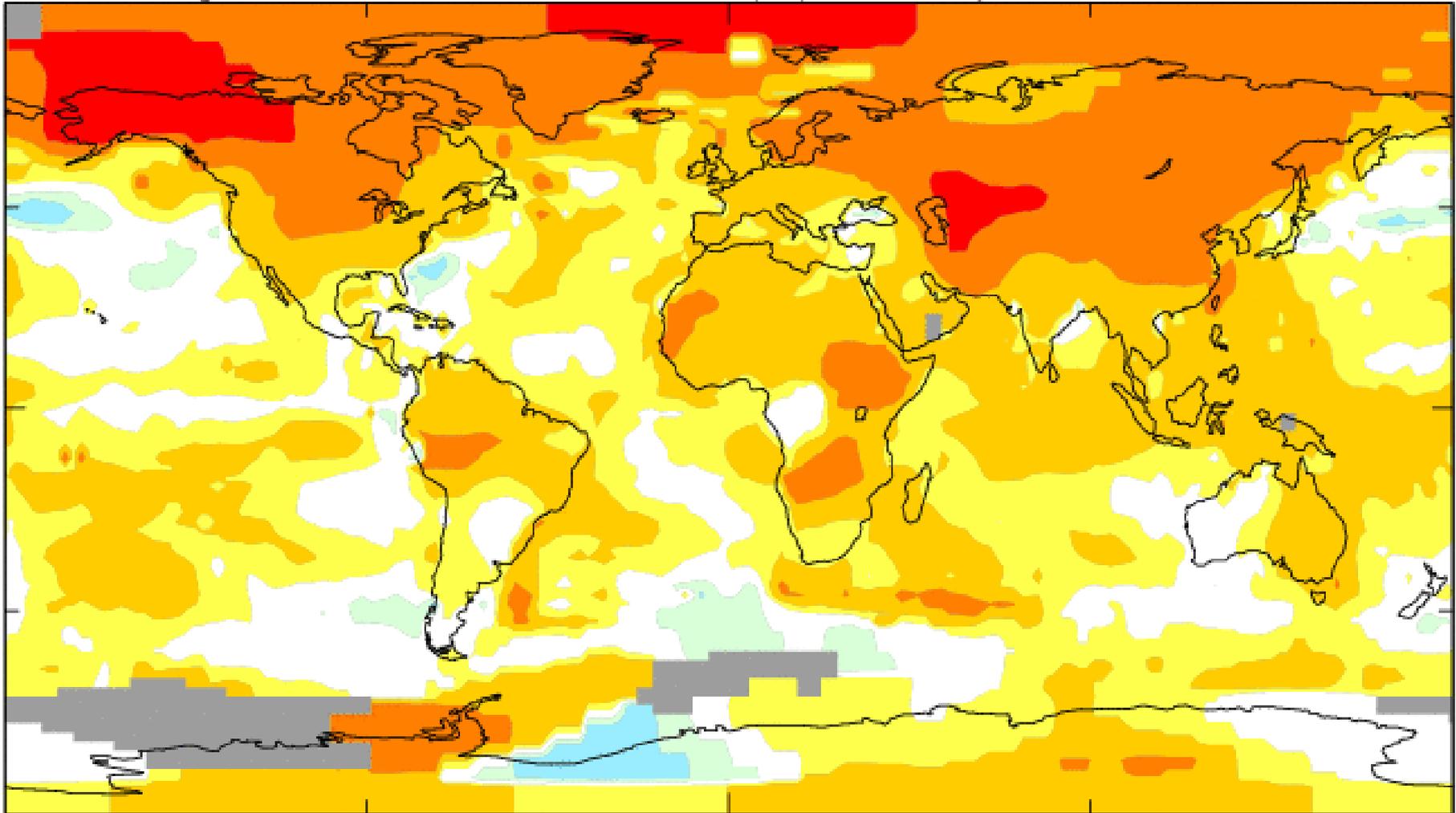


# Global Temperature Anomalies: 2001-2006 (Nov-Apr)

Nov-Apr 2001-2006

L-OTI(°C) Anomaly vs 1951-1980

.55



**NASA GISS**

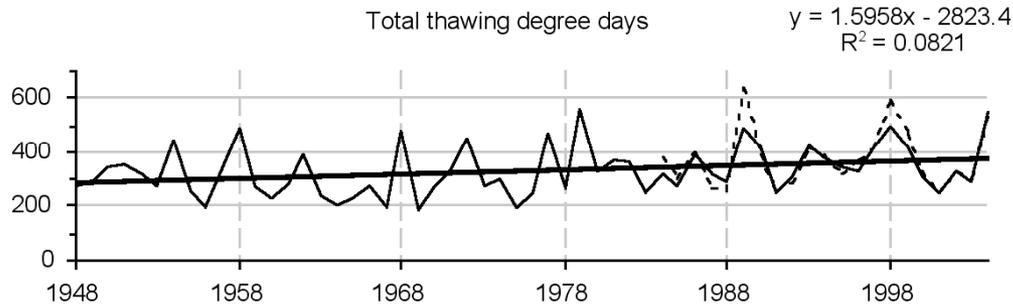
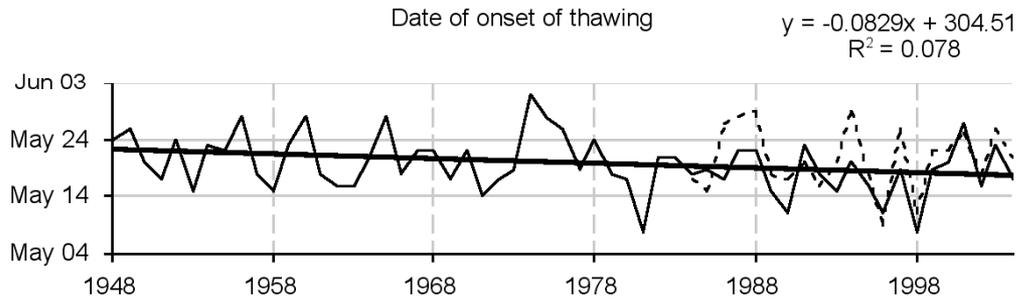
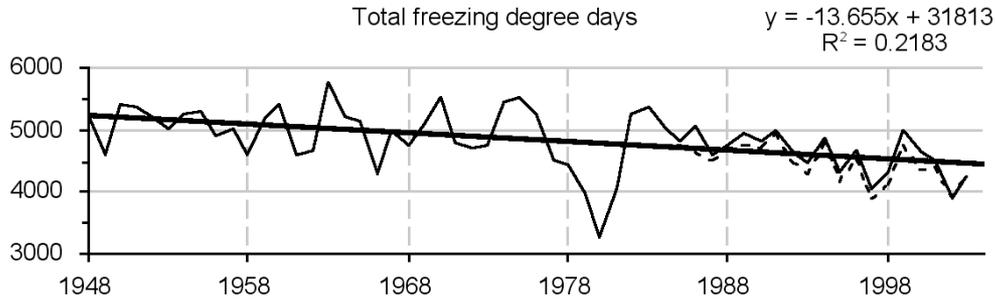
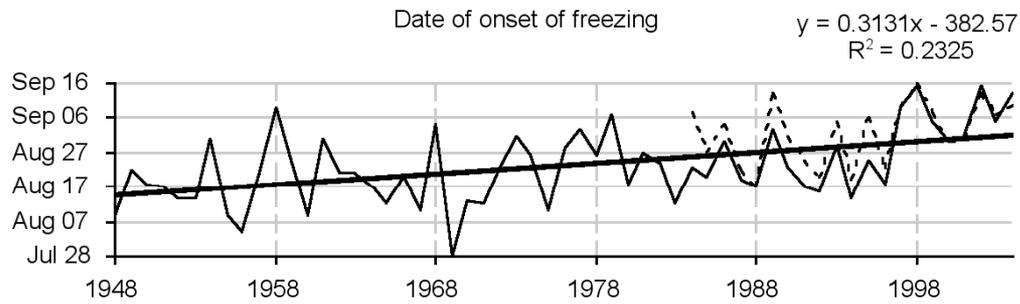
# Changes of Alaskan station temperatures (°F), 1949-2006

*[ from Alaska Climate  
Research Center ]*

Location	Total change, °F (1949 - 2006)				
	Annual	Spring	Summer	Autumn	Winter
<b>Arctic</b>					
Barrow	3.8	4.2	2.5	2.1	6.1
<b>Interior</b>					
Bettles	4.0	4.8	1.8	0.9	8.5
Big Delta	3.7	3.9	1.3	0	9.7
Fairbanks	3.6	4.2	2.2	-0.2	8.1
Gulkana	3.0	2.7	1.0	-0.3	8.3
McGrath	4.0	5.0	2.8	0.6	7.6
<b>West Coast</b>					
Bethel	3.7	5.3	2.4	0.3	6.9
Cold Bay	1.9	2.6	2.1	1.1	2.0
King Salmon	4.3	5.5	2.0	0.7	9.2
Kotzebue	3.2	2.1	2.4	1.4	6.8
Nome	3.0	4.0	2.5	0.7	4.9
St. Paul	2.3	3.3	3.2	1.5	1.5
<b>Southcentral and Southeast</b>					
Anchorage	3.4	4.1	2.0	1.0	7.2
Annette	2.4	2.9	1.9	0.3	4.1
Homer	4.3	4.6	3.7	1.8	7.0
Kodiak	1.5	3.1	2	-0.1	1.5
Juneau	3.6	3.5	2.4	1.4	6.8
Talkeetna	5.3	5.7	3.3	2.2	9.3
Yakutat	2.8	3.5	2.0	0.2	5.1
Average	3.4	3.9	2.3	0.8	6.3

Color code: -1 - 0 0 - 1 1 - 3 3 - 5 5 - 7 7 - 9 > 9

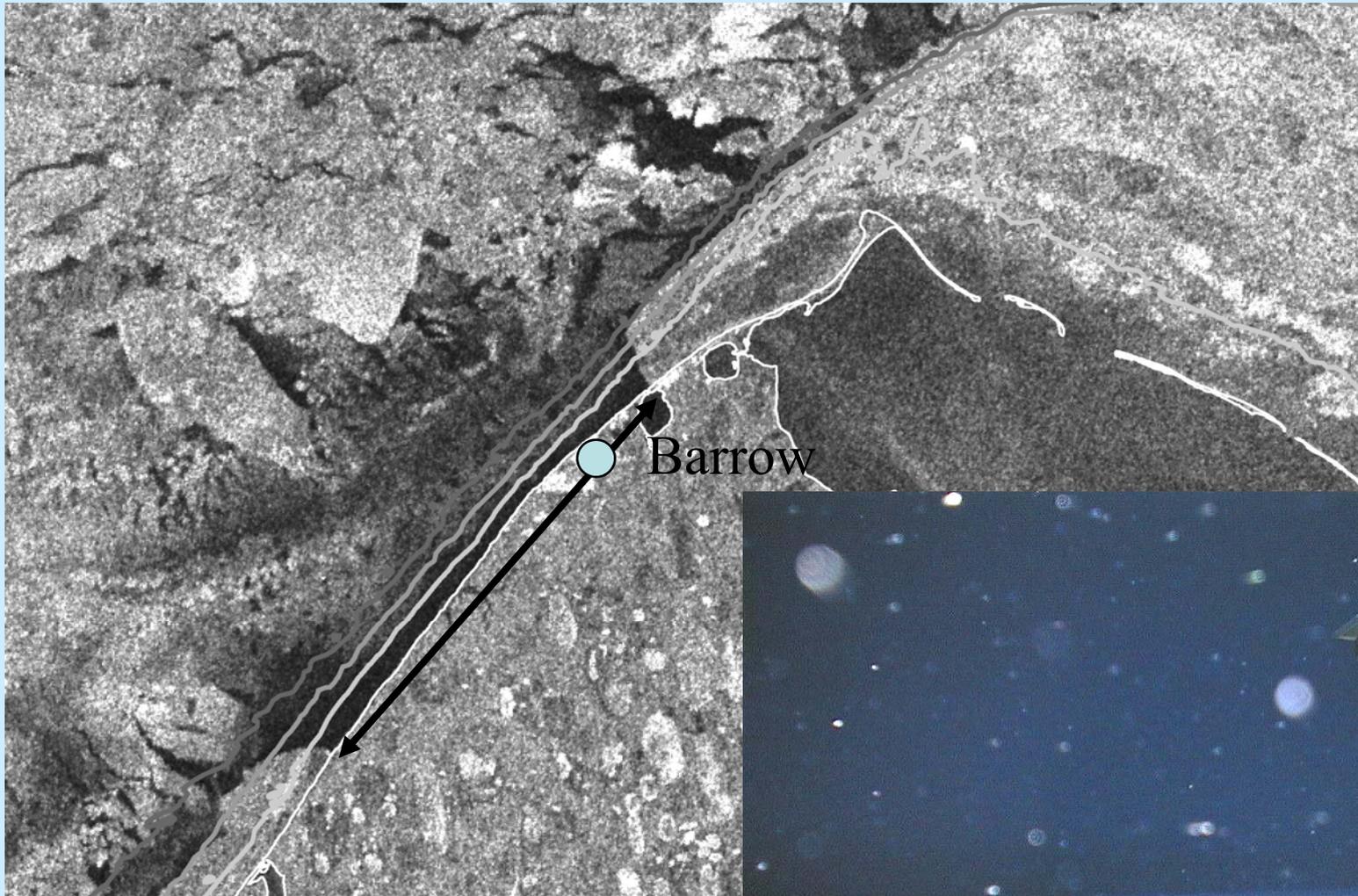
# Changes in freezing and thawing



# **Landfast ice stability**

- **Local observations and traditional environmental knowledge indicate a less stable coastal ice cover**
- **Impacts on travel over ice, subsistence harvests of marine mammals**
- **Significant hazard in some areas**

- **Increase (over past 4-5 decades) in winter sea-ice break-out events**



**December 13, 2001: Ice breaks out from stretch of coastline SW of Barrow past NARL (>15 km)**



Photo: Craig George

# Alaska coastal communities' response to changing ice conditions: Resilience and adaptation - Barrow subsistence whaling

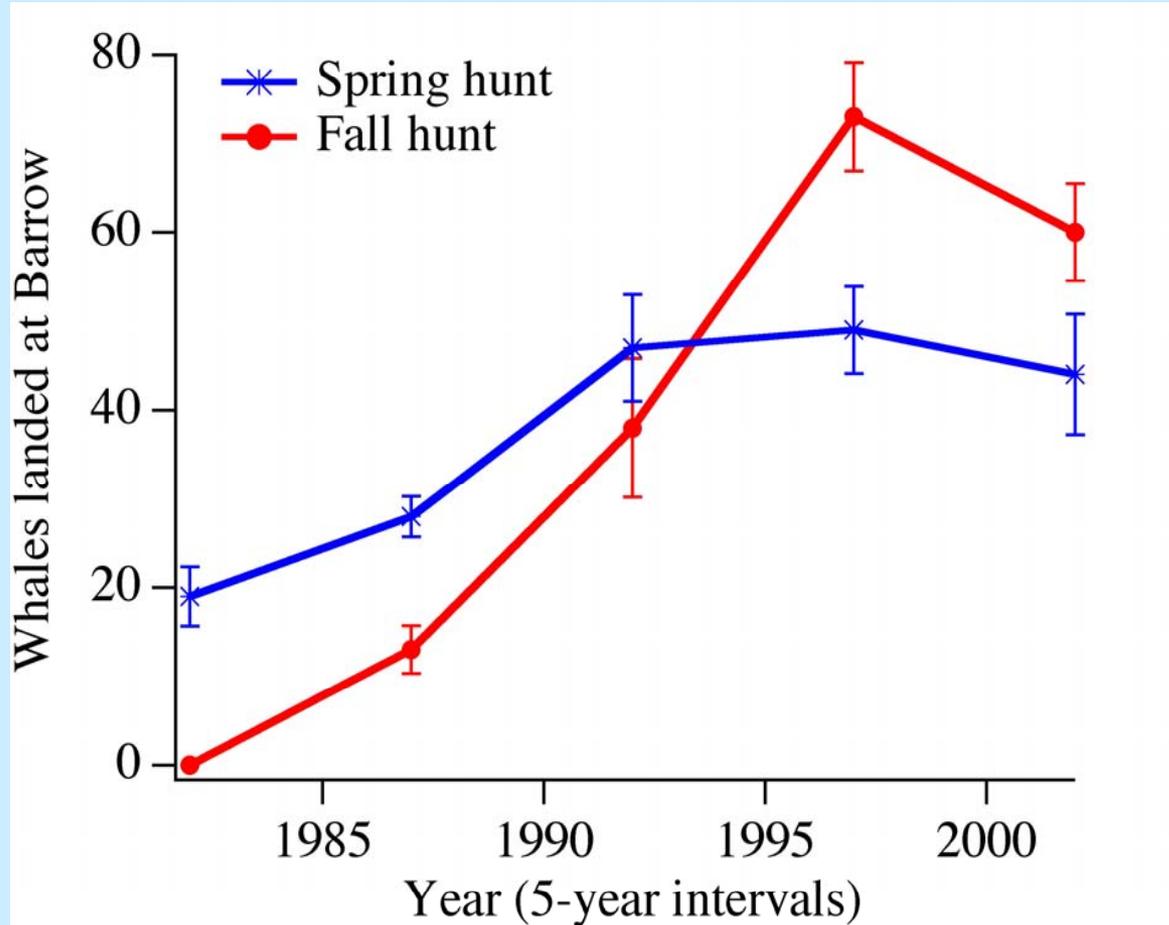


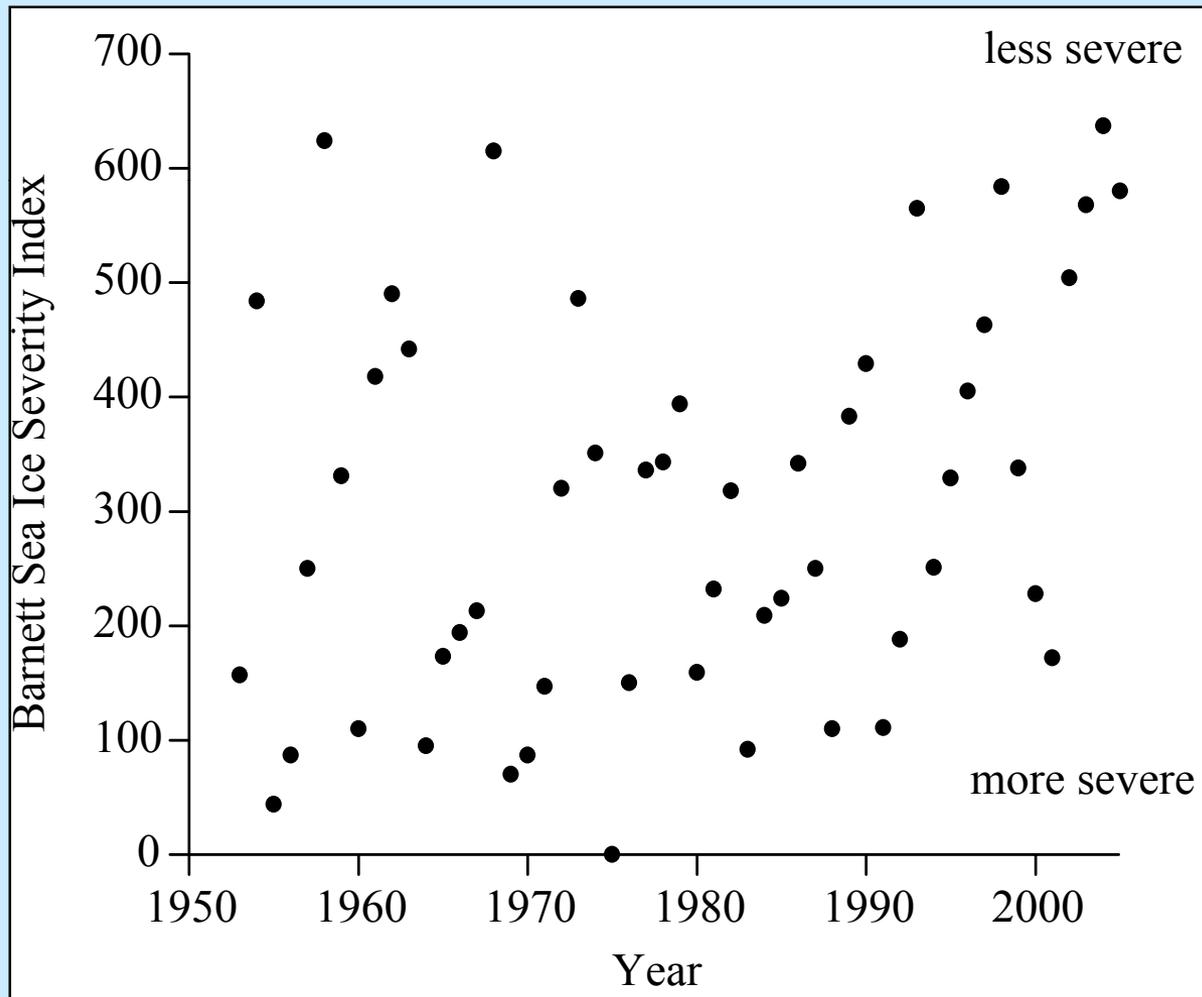
Photo © Bill Hess



Photo © Bill Hess

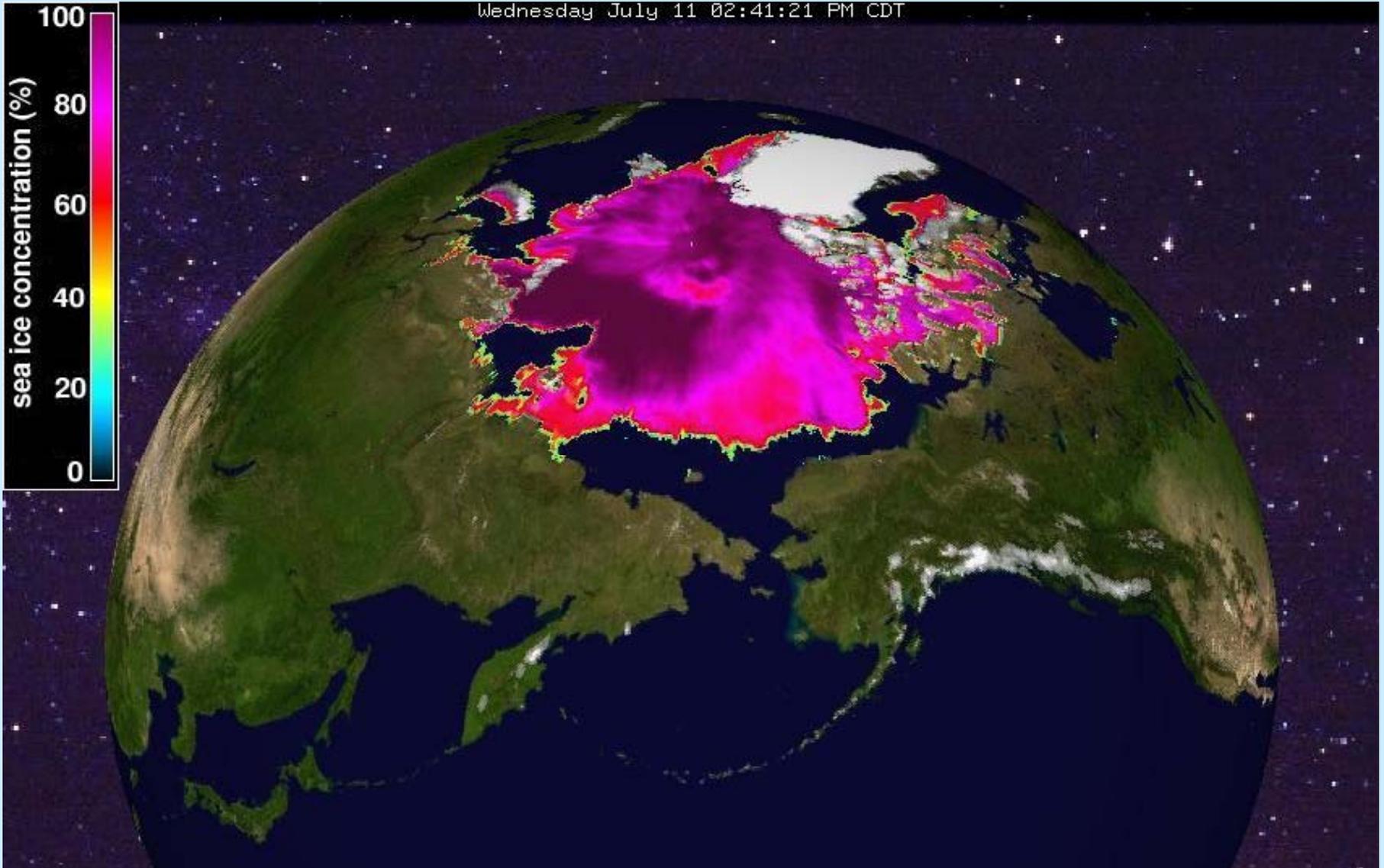
# North Slope Ice Navigation: Barnett Sea Ice Severity Index (computed by National Ice Center)

- severity of *summer* ice in coastal Chukchi-Beaufort Seas
- length of Barrow-Prudhoe navigation season

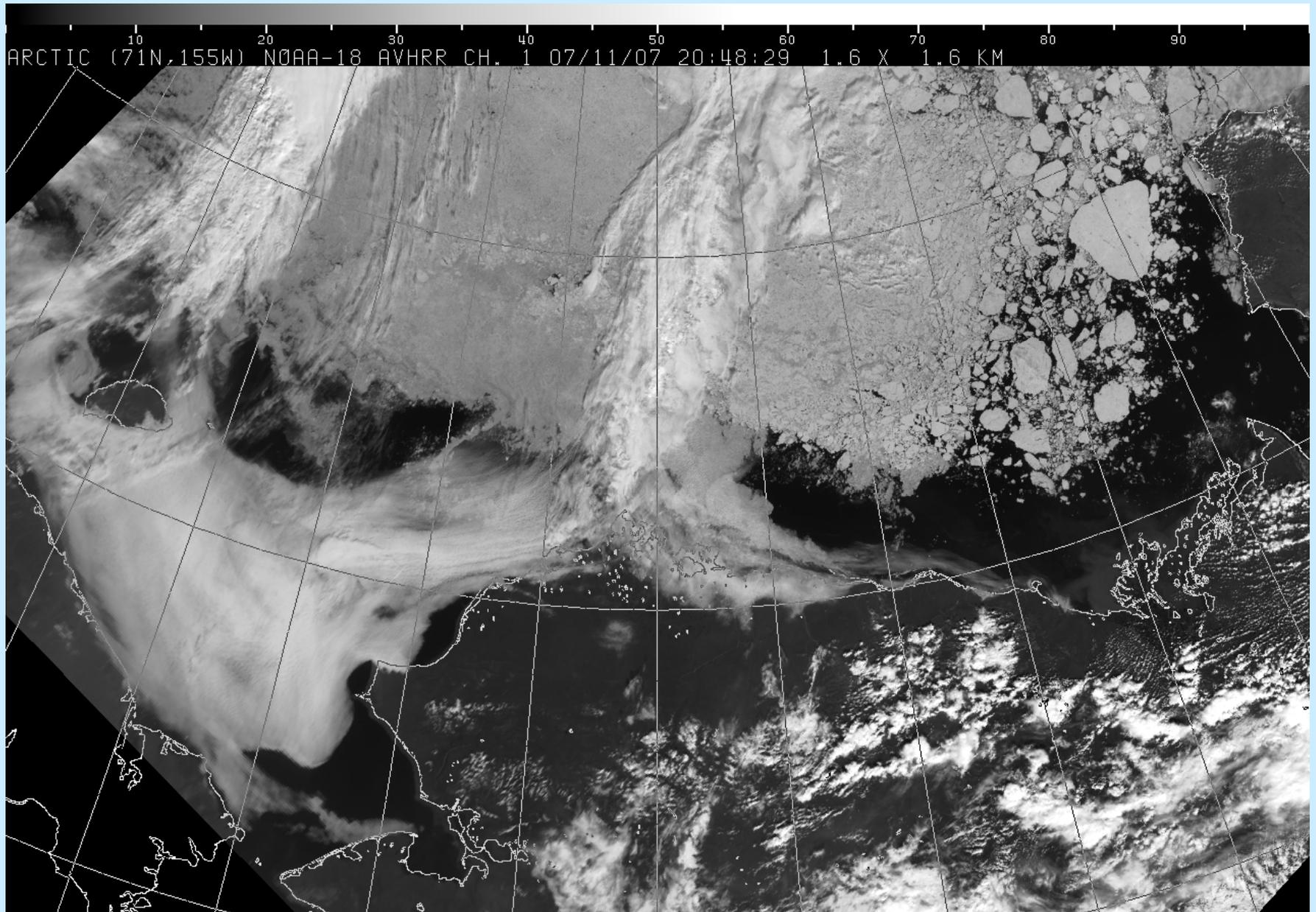


**July 11, 2007**

Wednesday July 11 02:41:21 PM CDT



**July 11, 2007 2100Z**





# IMPACTS OF A WARMING ARCTIC

**Many coastal communities and facilities face increasing exposure to storms.**



# Abandoned residence in Shishmaref, AK

(Photo by John Lingaas, Fairbanks WSFO)

